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Resilient Future: The Cultural Riverfront Edge in the New Capital, Amaravathi, in Andhra Pradesh, India

Priyanka Malik

Louisiana State University and Agricultural and Mechanical College, pmalik@lsu.edu

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RESILIENT FUTURE:
THE CULTURAL RIVERFRONT EDGE IN THE NEW CAPITAL, AMARAVATHI,
IN ANDHRA PRADESH, INDIA

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfilment of the
requirements for the degree of
Master of Landscape Architecture

in

Robert Reich School of Landscape Architecture

by
Priyanka Malik
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TABLE OF CONTENTS

ACKNOWLEDGEMENT	ii
ABSTRACT	iv
CHAPTER 1. INTRODUCTION.....	1
1.1 Addressing the issue.....	1
1.2 Overview of Andhra Pradesh and New Capital site.....	1
CHAPTER 2. LITERATURE REVIEW	5
2.1 River, Region and Capital Site	5
CHAPTER 3. METHODS.....	10
3.1 Precedent study.....	10
3.2 Social cultural water management and river fronts in India	12
CHAPTER 4. RESULTS AND DISCUSSION	16
4.1 Design concept.....	16
4.2 Site plan and Site details.....	18
4.3 Opportunities	23
CONCLUSION	26
REFERENCES.....	27
VITA.....	29

ABSTRACT

India faced the bifurcation of a united Andhra Pradesh state into the state of Telangana and state of Andhra Pradesh or Seemandhra, on 2nd June 2014. Since the year 1948, the city of Hyderabad remained the capitol of united Andhra Pradesh. However, post the bifurcation, the two states are required to share Hyderabad as their administrative capitol for ten years after which the city of Hyderabad will be the centre for the state of Telangana. The state of Andhra Pradesh is thus building a new capital Amaravathi, along the banks of Krishna River. The name of the capital is borrowed from an existing neighbouring historic settlement with the hope to bring in a sense of pride associated with the settlement. The site for the new capital city is central to the entire state and can be easily connected to important cities within and outside Andhra Pradesh. However, the capital location is known for its long agricultural industry sustained by the availability of fertile soil and the presence of water from the river. The vision plan proposed by the government offers a bright future thriving on the idea of a smart city. The plan is dotted with high rises along the river, and grey infrastructure - a term used to describe man-made engineered systems - clearly defines the river flow specifically at the centre of the newly planned city. The approved scheme by the government, promotes elite activities like golf course and luxury resort on the island by embanking the river. The government approved proposal ignores the agricultural past of the place; under plays the potential of retaining natural systems and the need to work with nature; and partially addresses the social and cultural aspect in the spatial description at the central water-front edge.

The thesis chooses a site in the submitted plan by the government, where there is an indication of an engineered edge and a suggested public space. The proposed thesis project aims to develop strategies which can transform the engineered riverfront, shown in the government approved plan, into an ecologically resilient, social and cultural river bank. The scheme analysis the capital site's existing condition and agricultural past and demonstrates the use of socio- cultural landscape intervention to create a public landscape infrastructure which is in tune with the environment and sensitive to the natural systems. By developing strategies that root from the socio - cultural relationship with water, the proposed scheme tries to celebrate the cultural ties between humans and landscape.

CHAPTER 1. INTRODUCTION

1.1 Addressing the issue

Amaravathi, the new capital of Andhra Pradesh, is proposed to be built along the banks of Krishna River, upstream of the city of Vijayawada. The government's proposal for the development, illustrates an engineered riverfront. In addition, the scheme falls short in demonstrating the social and cultural relationship with water and ignores the existence of farming in the site. The thesis comments on the need to work with nature for the upcoming capital. Presuming that the plan will be executed, the thesis project chooses a site to show that design rooted from the socio-cultural relationship with landscape can help in creating an environmentally sensitive landscape and reflect the history of the place. The socio- cultural relationship is shown by developing various strategies, along the river bank in the centre of the capital to create a resilient river fringe. The strategies are embodied and innovated from the social cultural ties between humans and water in India.

1.2 Overview of Andhra Pradesh and New Capital site

On 2 June 2014 India faced the bifurcation of a united Andhra Pradesh state into the state of Telangana and state of Andhra Pradesh or Seemandhra. Since the year 1948, the city of Hyderabad has been the capital of united Andhra Pradesh. Post the bifurcation, the two states are required to share, Hyderabad as their administrative capital for ten years after which the city of Hyderabad will be the centre for the state of Telangana. The state of Andhra Pradesh is hence required to build a new capital which can serve as an economic and an administrative centre. Hyderabad has been a culturally and economically dynamic city even before India received Independence. Having to share a temporary capital with Telangana, Andhra Pradesh is in dire need to replace not only the psychological but also the economical loss of Hyderabad. Thus, lies the burden on the state of Andhra Pradesh to build a capital city which can match the economic and cultural vibrancy of Hyderabad. The government of Seemandhra, in their hunt for a new capital, narrowed down on a site which is located on the banks of Krishna River central to the state, in the Guntur district. However, the proposed location for the capital is predominantly on the flood plain of the river. The capital location itself, is known for its long agricultural industry sustained by the availability of fertile soil and the presence of water from the Krishna River. The ruling ministry of A.P signed a "MoU" (Memoranda of Understanding) with the government agencies of Singapore to develop the vision plan ("A.P., Singapore ink pact to build capital"). The projected development by the Singapore agencies, further

agreed by the Government of Andhra Pradesh, promises a bright future thriving on the idea of a smart and green city. The scheme is dotted with high rises along the river front and the water-body is proposed to be banked along the edge of the capital, in-order to encourage commercial development and handle flooding (seen in Figure 1).



Figure 1: Image showing the impression of the proposed city.

Source : Asvin, Ang Chit Sik, et al. "Draft Seed Development Master Plan Report." *Andhra Pradesh Capitol Region Development Authority*. Surbana International Consultants PTE LTD, Jurong Consultants PTE LTD, 20 July 2015. Web. 23 July 2015.

The site selected is a 391 sq km (Asvin et al, 7) green-field development located largely in the Guntur district. The capital is officially referred as "Amaravathi" a name borrowed from a neighbouring village which has Buddhist and Hindu historic roots ("Capital of Andhra Pradesh to be called Amaravathi, After Satavahana city"), with the hope to bring in a sense of pride associated with the old settlement. The chosen capital location is central to the state and offers easy access via national highways to other major cities within the state, like Vijayawada, and outside the state like Hyderabad, Chennai (capital of the state of Tamil Nadu) and Jagdalpur (a city in the state of Chattisgarh), ("The Capital Region Plan and Report, 8). The 2011 census state that the "66.19%" of the population, in the

entire Guntur district, lives in rural areas (census2011.co.in). The capital site itself has 31 villages, and the prime industry of the place has been agriculture (see land use map Figure 2). The current population within the site boundary is 265,056 and some of the settlements with the highest population are Mangalagiri, Tadepalli, Penumaka and Thullur (Asvin et al, 10). The Guntur district, within which the capital site falls is referred to as "crop intensive districts," of Andhra Pradesh (guntur.ap.gov.in). The state is alluded to as the 'Rice Bowl of India,' and the region chosen for the capital city makes a major contribution in the production of the crop ("Andhra Pradesh- Rice Bowl of India"). Most of the fertile land will be lost in the hope to build a new capital.

In the 21st century when most state capitals in India are established with distinguished functions, Andhra Pradesh is struggling to create a new identity through the example of the proposed planned capital; this phase is therefore important in the state and national history. The choice of location and the planning steps can serve as an example, of either a city co-existing with natural forces, or a city, self-created for ecological disaster by attempting to have man-made systems dominating nature.

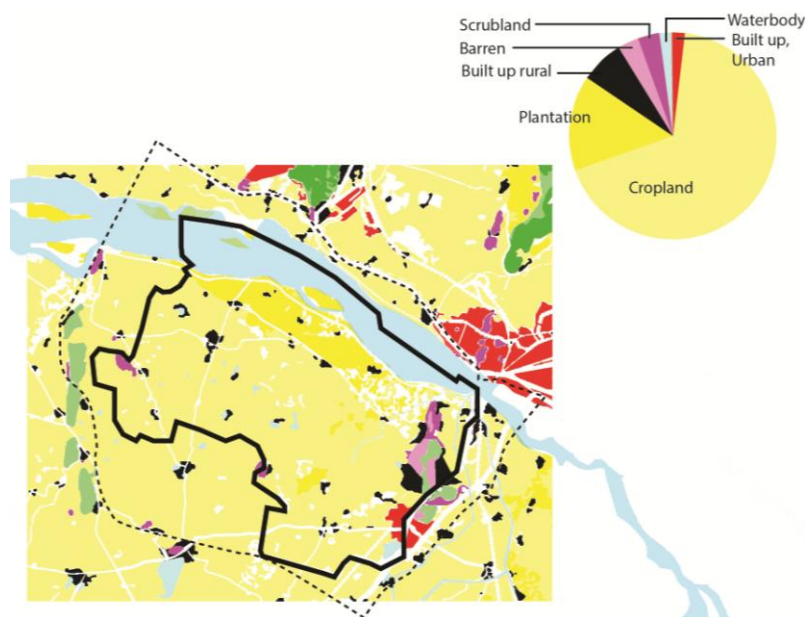


Figure 2: Land use map of the capital site.

Data source for the image: "Bhuvan Andhra Pradesh- Land-use." *Bhuvan- Indian Geo Platform for ISRO*. Government of India, 2014. Web. 1 Nov. 2015.

Emerging new cities in India usually evolve from village settlements on agricultural fields, because it is easy to construct on a green-field development. The issue at hand is the necessary understanding of creating a city which is not just blocks of grey infrastructure along the river, and on

the river. The idea of not allowing engineered systems to dominate natural forces is significant because the need to manage natural resources is an important part of the bigger ecological challenges being faced, not just by India but the world. Many cities all across the globe, are working with the natural environment, in order to preserve the innate forces of this highly essential resource (Hough, 263). Thus it becomes extremely crucial to reconsider water management along the edge of the river course in ways which are ecologically sound, and build a familiar relationship between the river and the people. A small change can help re-imagine a city, which is not just technologically advanced but also sustainable.

CHAPTER 2. LITERATURE REVIEW

2.1 River, Region and Capital Site

The Krishna River is known for its "soil erosion" and regular flooding, which is a concern while attempting to urbanise land on its bank and channelizing the river through grey infrastructure, along the edge (Sathish, 3). One of the longest rivers in the country, its southern basin lies in the state of Andhra Pradesh. In the past, the river has caused heavy floods resulting in loss of life, property, and agriculture production that has occurred for a long time along its bank. The first recorded flood that hugely impacted the lives of many, is known to have occurred in the year 1903. Many parts of the future capital site suffered damage due to flood in the recent years: 2005, 2007, 2008, 2009, 2012 and 2013 (few maps seen in Figure 3). The destruction caused during the 2009 floods surpassed the one caused in the year 1903. The multi-purpose Nagarjuna Sagar dam in the west of the site boundary and the Prakasam barrage in the east of the site, were unsuccessful in retaining water in 2009 for long hours, causing additional damage in the capital site and other major cities of Andhra Pradesh. The Prakasam barrage, is of major significance because it was constructed to build a connection across the river, and to provide regulated irrigation to the fields downstream of the river, some of which are part of the selected capital site. The barrage is not particularly meant for storage, but it directs the water in the East and West Canal of the Krishna River (Reddy, 12-22). The peak discharge volume of Prakasam barrage is 10,60,830 cubic foot per second, and the maximum flood observed in 1903, witnessed 12,00,000 cubic foot per second of water discharge ("Prakasham Barrage"). Flooding is a cause of worry, and there is a necessity of reinforcing water management systems in ways which are resilient.

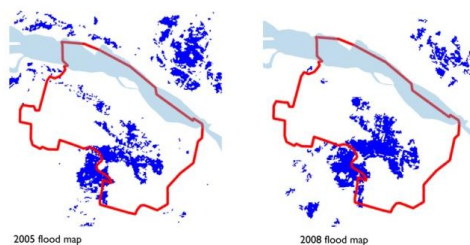


Figure 3: Image showing floods areas in some of the recent years within the capital boundary.

Data source for the image: "Bhuvan Andhra Pradesh- Disaster Specific Dataset." *Bhuvan- Indian Geo Platform for ISRO*. Government of India, 2014. Web. 1 Nov. 2015.

A closer look at the Krishna River, reveals its tendency to meander, depositing soil and creating land. Nearly 30-40 % of the capital site is land formed of fluvial origin. The physical evolution

of the site is thus a strong indicator of the site substantially under active flood plain (seen in Figure 4). The preeminent flatness of the site with a slight slope towards the river, evidences that the Krishna River carries out its sedimentation process in that area (seen in Figure 3). The site also has ground water available at a depth, ranging from 2m to 30m, and in some parts beyond 30m (seen in Figure 4) (Kumar, 13). The minimum temperature of Guntur district is 15°C (59 Fahrenheit) and the maximum is 47°C (116 Fahrenheit), and invariably due to high temperature, the land experiences dryness. In addition, with only annual rainfall of 906mm, Guntur is vulnerable to drought, and the central spine of the proposed capital will suffer from it (seen in Figure 5) ("Climate: Guntur"). All the facts combined indicate that the tropical - semi arid region, has good ground water resource but the rainfall can sometimes cause flash floods. The severe hydrological imbalance, and need for a resilient method for flood protection, all signal towards sensitive planning with minimum use of grey infrastructure in the flood plain, for a real model of a green city.

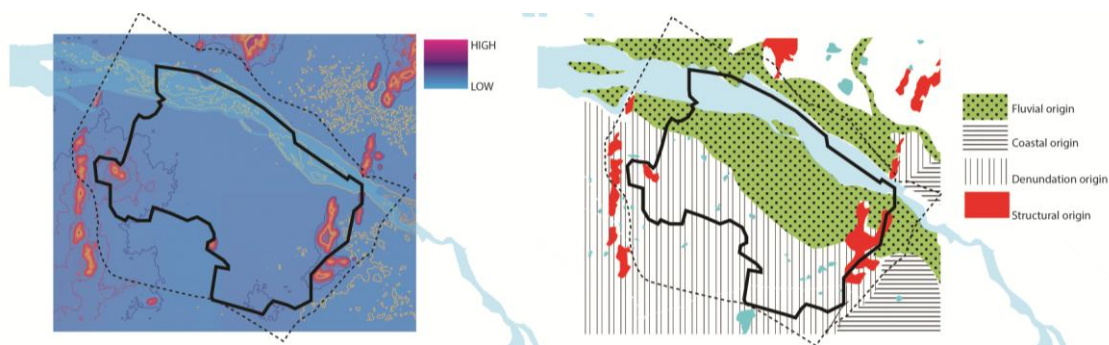


Figure 4: (Left) map showing flatness of the site, (right) map showing capital site predominantly in the flood plain.

Data source: "SRTM 90m Digital Elevation Database V4.1." and "Bhuvan Andhra Pradesh."

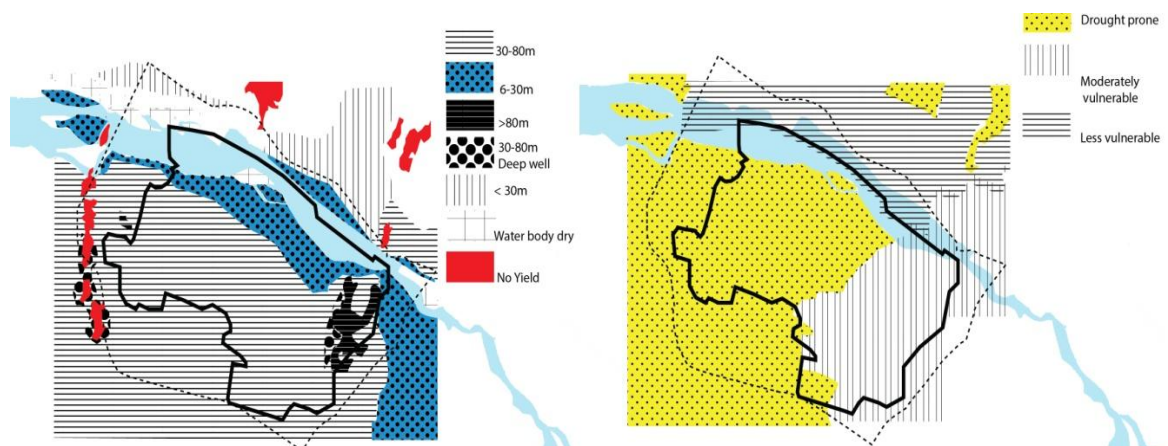


Figure 5: (Left) map showing ground water availability on the capital site. (Right) Map showing drought prone areas in the capital site.

Data source: "Bhuvan Andhra Pradesh."

The region has over 70% of black cotton soil with varying content of red soil, alluvium soil, and coastal sandy soil ("Situation Analysis Andhra Pradesh," 10). The soil available is quite good for crop production, hence agricultural activity has been predominant within and outside the capital site. The region being paramount in agricultural production, has three seasons of crop growth : monsoon or rain-fed crops also known as the *Kharif* season, occurring quite early as May and lasting till January; winter time also known as *Rabi* season, occurring between January to March, and lastly the summer. *Zaid* season, occurring between March-May/June (crop yield, season and festival data, mapped and see in Figure 6). Regional data indicates that paddy, cotton, chilly, jowar, subabul, black gram, turmeric, fodder grass, maize are crops that most farmers cultivate in the rainy season. Around "25 bags /acre " of paddy yield is possible in this season ("Situation Analysis Andhra Pradesh, 27"). The *Rabi* season, usually witnesses the production of crops like jute, chilly, turmeric and sesame with "15 bags / acre / yield" ("Situation Analysis Andhra Pradesh," 27). Fruit crops like banana, lemon, orange, papaya and mango are cultivated all year long. Banana is considered an easy revenue builder, and is a common crop. Turmeric is a recurrent spice crop, and gourds, lady's finger are frequent vegetable crops. Chillies are grown all through the year, as a common vegetable crop, and make a crop rotation substitute for paddy. The staple food of most people in AP is rice, which explains the reason, paddy production dominating the crop scenario. It is a known fact that paddy requires large quantity of water, and agriculture in the Guntur region is either rain-fed or through irrigation canals from the river. An equally important facet is that paddy is a semi aquatic plant, and therefore can tolerate flooded conditions (Abdullah, 5). Apart from food crops, the farmers also practiced floriculture and produced flowers. Flowers like jasmine, marigold and crossandra are often used in festivals and can bring easy income. One cannot cease to notice, that most often traditional systems of ecological management work best for the environment. In the case of the new capital site, it is clear that farmers used, and worked around the climatic season for crop production, which meant least effort but more gains.

Coupled with the local ecological system is the social structure. Crop harvest is marked, not only in Andhra Pradesh, but the whole country, by different names. In Andhra Pradesh, the yield time is celebrated, by the festival name Sankranti. During this time, the farmers celebrate the harvest produced, through a period of four days, with each day devoted to specific celebration. The festival, marks the new beginning, respects the past and offers prayers to ancestors, thanks mother earth for food production, and the animals which helped in agriculture, especially cattle ("Different celebrations

of Makar Sankranthi across India)." Furthermore, the festival is considered to have astronomical significance; the phase when the sun enters into the astrological sign Capricorn ("Makara Sankranthi)." Overall culture of the festival inherently commemorates nature.

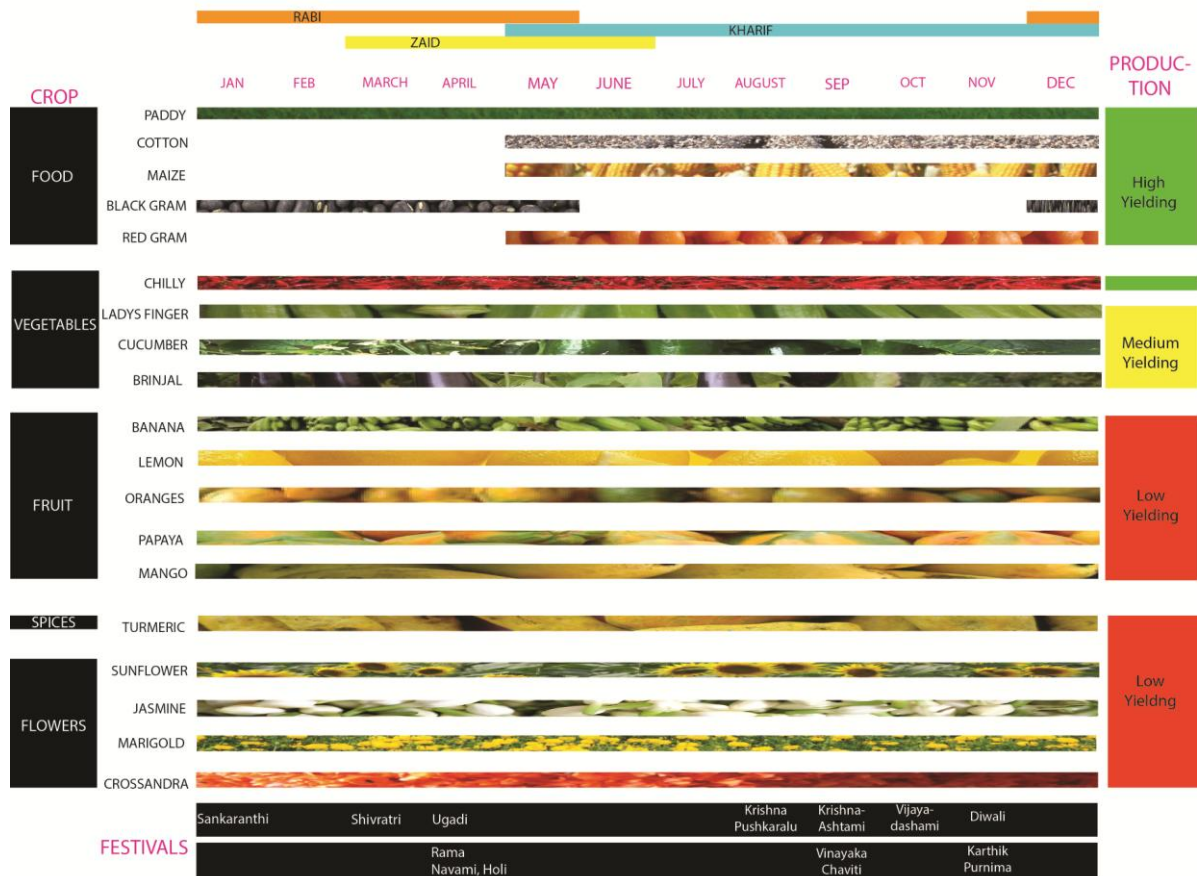


Figure 6: Map showing common crops, yield state, season of crop and festival in the Guntur region.

The capital site vision of building a city of the future, started out by first acquiring 33,000 acres of agricultural land through land pooling; where the villagers contributed their land for the to-be capital city, and in return received compensation ("Capital land pooling : Disadvantage farmers?)." The capital site, based on the above review, is evidently, proposed to be built on fertile grounds, and on the Krishna River flood plain. The government scheme tries, and resolves the ecological problem, especially flood, by proposing to bank (levee) the river edge. The water shortage problem for the millions of people who will reside in the new capital, is addressed by implementing large reservoirs scattered in the capital. Since the site is considerably flat, the scheme is to raise the land, by fill of approximately 2m. The government scheme promises to have a population of around 2.4 million by 2050, and approximately one million job opportunities (Ramachandraiah). The central administrative,

and commercial business development, referred to as SEED, extends into the river to broaden the CBD development, by suggesting golf course and luxury resorts onto the island in the river.

The current condition of the Krishna River in the capital region is at an easy stage to undertake, verses the condition that will be created by cutting of the river bank, and raising it to build on the flood plain. In an article by C Ramachandraiah from the Centre for Economic and Social Studies (Hyderabad, India) very crucial observations on the proposed plan, and economic projections, can be drawn, for reconsidering the use of grey infrastructure in the flood plain. Elaborating on Ramachandraish's idea's, the design for the capital city is proposed for close to 3 million people whereas according to the current scenario, the whole district in which the capital is located has the same population figure. According to the 2011 census, the population of Guntur district reaches around 4,890,000. We could blame that on its agricultural set up, but imagining a 5 million population for the entire capital city, by 2050, and expecting people to thrive in immediately, is questionable and rightly pointed out by Ramachandraish. The analysis however, does make you hope that a large chunk of land in the flood plain can be saved from urbanisation. It is also reported in the same article that, over 10,000 acres of land is going to be raised, which will cost 15 billion rupees (Ramachandraiah). It would perhaps, be comparatively less expensive to design a natural system which can offer passive recreation, maintaining ecological balance, and bringing in the economic benefits.

The plan lacks the incorporation of the past, in the need to build the future. The primary activity of agriculture, which clearly mirrors the social, ecological culture and extends into the economic culture of the place is missing within the location of the development. Furthermore, engineering the river edge would be disrupting the natural functioning of the river.

CHAPTER 3. METHODS

3.1 Precedent study

The current planning proposals, and ideas of grey infrastructure development in the flood plain of Krishna River, can be alarming, especially when one is aware of the various methods of water management in other nations. It is relevant to discuss different examples, which suggest sensitivity to the environment, by means of novel strategies. The city of New Orleans is a powerful example of river management gone wrong. The city located along the Mississippi River, has witnessed floods, and storm surges for a long time. To continue its economic vitality which came about due to shipping activity, New Orleans required to be protected from floods and hence the city initially built natural levees for flood protection, which were later upgraded into concreted flood walls. The engineering achievements gave the impression of humans controlling nature, however the feat has become one of the major causes of disturbing the river ecology. The Mississippi River has thus become incapable of building land along its course; it also does not have the opportunity to replenish the groundwater causing subsidence. The sinking of land has put human life in danger, and questions are being raised on the future existence of the city. The recent natural disaster, Katrina, awakened the city to manage water, and the city is now trying to work on a proposal for developing water management systems, that will allow designing of 'blue- green infrastructure,' to cope with water in its fearful state (Mossop, 2). Paradoxically resilient water management strategies, along with social context, are being thought of, in the post disaster scenario where millions are being spent on redesigning natural systems, while millions more were spent in creating grey infrastructure in the first place.

Wadi Hanif watershed revitalisation in Saudi Arab, west Asia is another example of reconnecting nature after realising the untoward aftermath of urbanisation on environment. In the dry region of west Asia, Wadi Hanif is an important natural drainage way, which for a long time served people with its resources without exploitation, up until the time, Riyadh was built as the capital. The wadi (valley) suffered abuse, as a consequence to the increasing demand of natural resources it provided, in the form of water, soil and stone. According to the UNESCO report on Wadi Hanif, the ill effects of urbanisation were such that in-order to meet the demand for water, the city began to provide water available in the eastern province from a desalination plant while discharging the runoff into the Wadi. The human misuse of the natural resources lead to flash floods, and turned the valley into an uncovered sewage channel. In addition, disruption of the hydrological balance through activities such

as dumping of solid and liquid waste, the Wadi suffered environmental degradation losing out on its useful natural ecosystem. On discovering the negative environmental impact, the Wadi was suffering, the Ariyadh Development Authority, worked in collaboration with environmental planners and engineers, for ten years to fix the damage. The plan had established goals such as cleaning the Wadi bed, improving the flood performance, re-establishing the vegetation, providing recreation activities along the Wadi bed and making better facilities for the availability of clean water. The UNESCO reports reveals, that the redevelopment plan, did remove over a million cubic metre of waste that was dumped, and systems were designed to handle 20 years of flood. The surface water was proposed to be cleaned by various methods at a small and large scale like use of stone weirs and a Bio-Remediation facility (Samhouri, 17). The positive initiative by the government managed to develop a land use plan, along the Wadi, which defined land policies, and use along the Wadi belt. Today, after spending over a billion of dollars in fixing the natural system, the Wadi has become a beautiful example of a project which worked with nature to create a place valued not only for its recreational but also for its environmental role (seen in Figure 7). However, not all the projects have the luxury of time and money available to undo the results of environmental degradation.



Figure 7: Image (from left to right) showing the Wadi before and after revitalisation.

Source: Samhouri, Wael Al, and Mashary Al Nain. "Wadi Hanif Wetlands." *Environmental Protection and Development, UNESCO* (2007): 2. Web. 24 Oct. 2015.

The precedent studies, indicate that city planning development can work alongside nature. Both the projects, have chosen to have a resilient approach, unique to their setting in-order to render designs with nature.

3.2 Social cultural water management and river fronts in India

Rivers in India, have a social, cultural and religious significance, from historic times. Most civilisations have flourished along the banks of rivers, and water courses like the Ganga and Yamuna, are examples of that. The land and water coalesce is conspicuous by different socio- cultural customs expressed through landscape and architectural representation. The Hindus, consider the potential of water as an element which can cleanse them from their sins. Most rivers are associated with mythological stories that are incremental in visualising the river, as more than a mere water-body. Sinha in her paper on cultural landscape of Yamuna riverfront, elaborates on the Yamuna river's divine status, and expatiates the calm landscape associated with it, which is intrinsic to its role in the mythological story of Lord Krishna, a male god in Hindu religion. The scene is depicted in the local paintings, where Krishna is playing the flute amidst grove of trees on the bank of River Yamuna. Muslims, on the other hand have a different association with rivers. They neither adhere a divine status to it nor make it stand out apart from other water bodies. It has been an entity which can be used for transportation, and further be an attraction to real estate development. The same is seen in the development during the Mughal era, where most of the important developments were on the bank of river, in order to benefit from the view, and economic benefits. Muslims, often used shaded structures, riverfront architectural pieces, to get a glimpse of the vast water body. The Taj Mahal, although a tomb, made by a Muslim ruler, Shahjahan, was built on the river, and today it is one of the wonders of the world. Another example, mentioned by Sinha, is that of Babur, a Mughal ruler, who had gardens away from the river, with terraced pavilions, mainly to capture the view, and be safe in case of floods. Water has also been part of their personal spaces in the form of fountains or channels, examples of it can be seen in Humayuns tomb, New Delhi. The Hindus, on the contrary, have a tangible and visual association with water. The idea of sin washing, is experienced through a series of steps leading into the river, referred to as ghats. The ghats, run parallel to the street, which accommodates small scale economic business, like selling small articles. Sinha, observes that the street, along the Yamuna river front, acts as an entry into the ghat area. Ganga river front too, has an axis, sprinkled with small scale vendors, prior to approaching the ghats. Most of the times, the series of steps, are located in spots, which have a mythological relation, like birth of a god or goddess or any religious significant event. The divinity attached to the river in the Hindu culture, is also expressed by doing 'aarti' of the vast water body. Aarti, is a ritual, where lamps are held, and rotated in clockwise

direction while singing in the regional language. The entire process is a form of prayer. This activity is regularly seen in the evenings on the banks of the River Ganga, one of the most sacred rivers of India. The Muslim river front reflects, a regal connection while the Hindu alliance with water is soaked with the idea of religion (Sinha, 5). Whether Hindus or Muslims, people have a unique association with the river, and the connection is religious, economic and ecological.

The Krishna River, is considered as one of the sacred rivers of India. Although it rises from the western ghats, north of Mahabaleshwar, there is a general belief that it rises from the mouth of a bull statue in an ancient temple in Mahabaleshwar. The temple is of Lord Shiva, a Hindu god, and the bull or nandi is Lord Shiva's vehicle. The water from the mouth of the bull gets collected into a shallow water tank. The word Krishna means dark blue or black, and the river is the name of Lord Krishna, the incarnation of one of the three main deities, Lord Vishnu, the preserver or the protector in the Hindu mythology (Hamilton, 99). In addition, Krishna River is also associated with a zodiac sign, in the Hindu culture, like the other eleven important rivers (Ganga, Narmada, Saraswati, Yamuna, Godavari, Kaveri, Bhima, Tapti, Tungabhadra, Sindhu and Pranhita). When the planet Jupiter moves from one sign to another, the river associated with that sign, has a 12 day celebration period, in the honour of offering reverence to the natural body; the event is referred to as 'Pushakaraulu.' In 2016, the planet Jupiter will enter the sun sign, which is Kanya or Virgo, of River Krishna ("Krishna Pushkaram 2016"). This phenomenon happens once in twelve years, and is believed as a moment, when gods descent to the water body, and by taking a dip into the river ones sins gets cleansed. The social cultural format of the people, translates into landscape spaces, which can allow people to reinforce their association with the natural water body, and ghats are the best mode to render that expression.

The activities associated with the river, do have an impact on the socio - cultural matrix of a place, and the result is seen in the form of utilisation of the water body for human benefit. The new capital city, has had agriculture as its backbone for a long time. The economic activity, itself is a platform for socio- cultural involvement during harvest. Furthermore, farmers have deployed strategies to get the water from the river into their fields. Some known methods have been canal and tank irrigation. A system of 'gonchi,' referring to a communal participation of bringing in water from the rivulet into the field through a series of stages, is known to be practiced in a few areas of Andhra Pradesh (Saleth, 166). The main elements of this system are : Thalipri or trench, Gonchi or the main channel, sub distributor channels and ayacut or pond. By a system using gravity, the water is lead into

the first component. The second channel further carries water into the distributor channels, which further leads into the pond, and then finally into the fields. The de-silting of the first channel is carried out manually by the farmers together. The entire process, is monitored by the farming community collectively. On further investigation, one notices that understanding the water mechanism and use of it sustainably can be traced as far as 2000 years. The known example of it is the Sringaverapura, a village in Allahabad, located at the convergence of the rivers Ganga, Yamuna and Saraswati. The tank believed to be in existence over 2000 years with mentions in the Hindu scriptures, has a defined system of water harvesting. The river water first enters a tank referred to as a feeding chamber, the water then passes through two more chambers, wherein the silt of the river is allowed to settle. The river water then penetrates into the overflow final compartment, where it remains, until utilised by method of distributaries. An additional circular chamber is seen to store excess water ("Centrally Protected Monuments And Sites In Allahabad And Its Neighbourhood "). The circular chamber is said to be used for ritualistic purpose. The system in Uttar Pradesh is used for water harvesting and managing flood water. The system is unique and can be seen as a sustainable strategy to use river water for agriculture activity in the Krishna river front.

Tanks are used in India for rain water harvesting in-addition to irrigation. Rain water harvesting is a common method designed in various spatial forms, by either villagers for farming or by kings and temple authorities, to provide sufficient water supply for people in the local settlement. It is said that there are over 100,000 tanks, found in the semi-arid regions of India ("Irrigation Tanks...", 1). Often, water tanks are designed for multi- purpose use, like that of water storage and irrigation supply. Quite like the gonchi system usually, farmers have informal set ups which undertakes water supply from these tanks. Furthermore, it is noted that the South Indian style of temple architecture or the Dravidian style, witnessed changes from a single shrine tower, to the shrine surrounded by tanks among other structures like smaller temples, sculptured halls (Smith, 149). The tanks in the temple or man- made basin serve varied functions like water storage, mitigation of flood and drought, and help in creating a micro- climate ("Irrigation Tanks ..", 1). In addition, tanks can become gathering nodes for people. A good example is the Adalaj stepwell in Ahmedabad which is a large water tank or step well. The place was functioned as rain water collecting tank and a cultural node for people. The Adalaj stepwell has series of steps and platforms dug deep in to the ground. The design has colonnades which add to the visual experience of the space apart from the play of levels.

Tourist and locals sit on the steps of these semi- open structures. Water management techniques are plenty in India, and some can be used for building a setting which is multi functional; serving as a recreational space and as a tool to direct water. A small scale version of the tanks is the idea of courtyard. They are seen in the centre of a house plan to have a cooler space, and form a place of gathering in the evenings for houses. The concept of having a gathering place with different levels can be used in the public infrastructure place.

CHAPTER 4. RESULTS AND DISCUSSION

4.1 Design concept

The existing site analysis draws the conclusion that, the capital site is prone to drought and floods. The submitted draft plan by the Singapore government agencies, overlooks the social cultural relationship of people with water and also promotes the development of grey infrastructure along the central edge of the river. The government's proposal suggests commercial activities for the elite, like a golf course and a luxury resort, ignoring the diverse economic strata of the region. The proposed thesis master plan, demonstrates an alternate to the central river front planning with suggestions of 3 zones: mixed use, cultural zone and ecological zone (seen in Figure 8).



Figure 8: Designed master plan, showing a possible resilient planning by having 3 zones: mixed use, cultural zone and ecological zone.

The site design proposal looks into strategies which subscribes flood and drought mitigation through social and cultural methodology. The site selected for the exploring the strategy is a 20 acre parcel, located in the central axis of the capital. The site is flanked by an island with commercial development (like a golf course and luxury resort) to its north; a food and beverage centre to its north west zone; a performance centre in its north east zone; and an office and hospitality development to its south. By developing this location, a cultural hub can be established which is part of a green system (seen in Figure 9). The plan has cultivable spaces, gathering nodes and relaxing spots (seen in Figure 10).

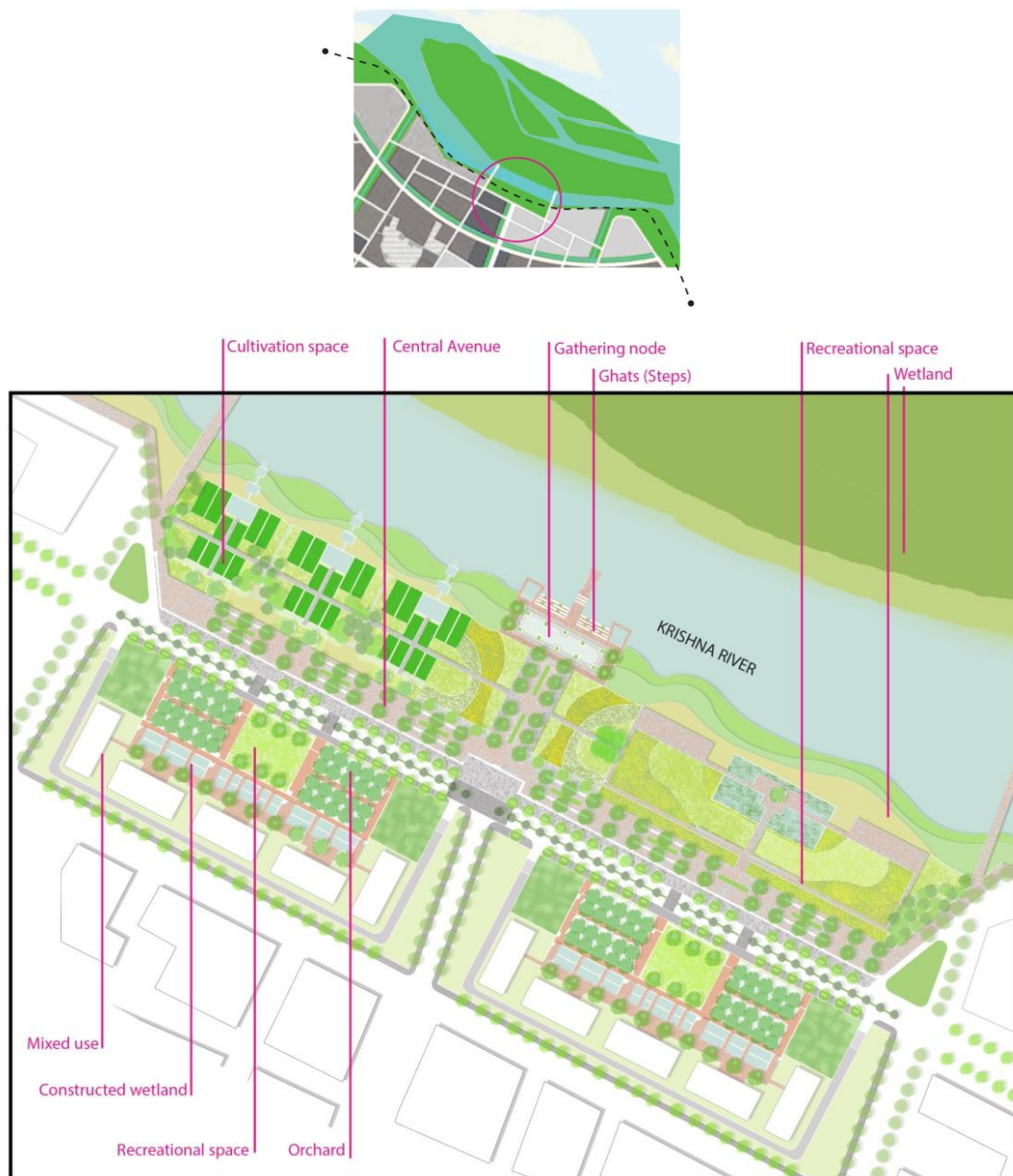


Figure 9 : (Top) showing proposed site as a part of the green connection, (bottom) site design plan demonstrates the possibility of a river edge which is culturally vibrant and ecologically sound.

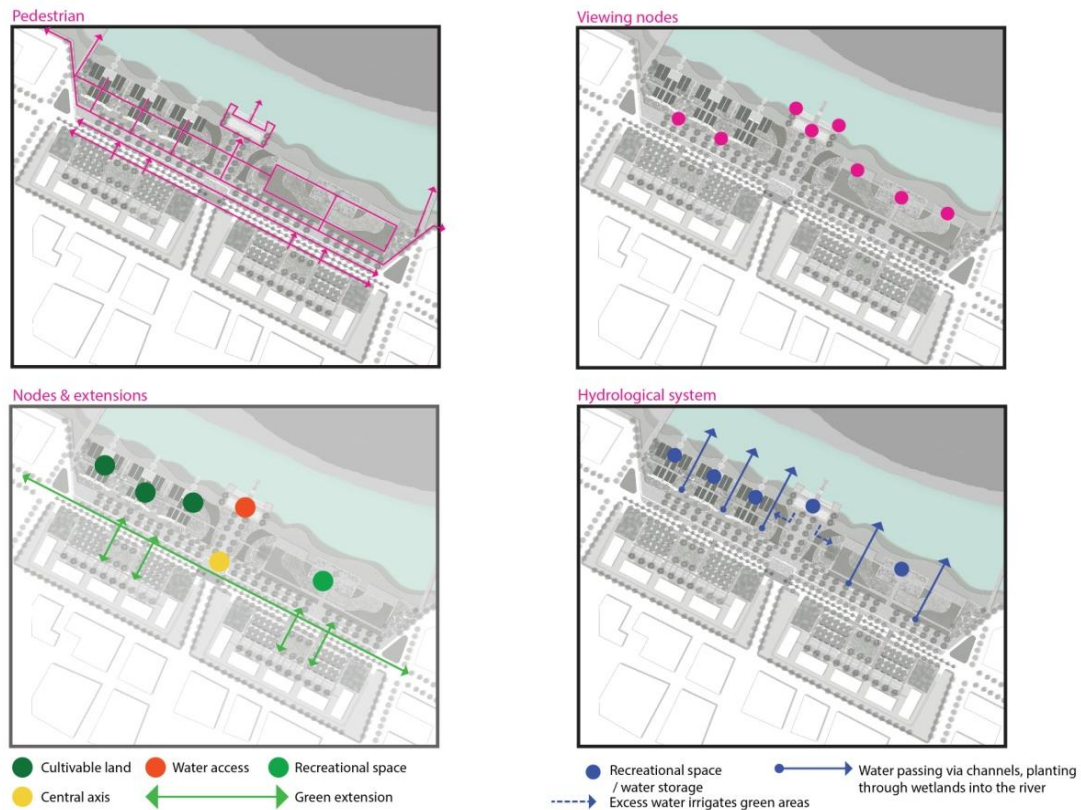


Figure 10: (Top left) map showing easy pedestrian movement, (top right) map showing viewing platforms, (bottom left) map showing green nodes and extensions, (bottom right) map showing movement of water through site.

The proposed scheme is divided into three resilience strategies :

1. Breathe: a strategy where the water flows into the site
2. Touch: a strategy which allows the land and water interface or has an experiential consequences of it in the spatial structuring
3. Release: a strategy which renders a visual connect and forms an event space

4.2 Site plan and Site details

The first strategy breathe, is inspired by the traditional water harvesting technique and pays ode to the farming culture prevalent in the site (seen in Figure 11). The design functions by allowing the river water to flow in through a system of three chambers. As the water moves from one chamber to another, it gets purified, and can be used for farming. The water from the fields, with the help of a water channel goes back to the river, passing through network of wetlands. The chambers help collect silt and fishes and other aquatic species. The silt and fish can be used in farming. The chambers also act as water storage structures. The space provided for farming can be used to showcase how crops are grown thereby providing a platform for the farmers to continue their profession. Flower crops,

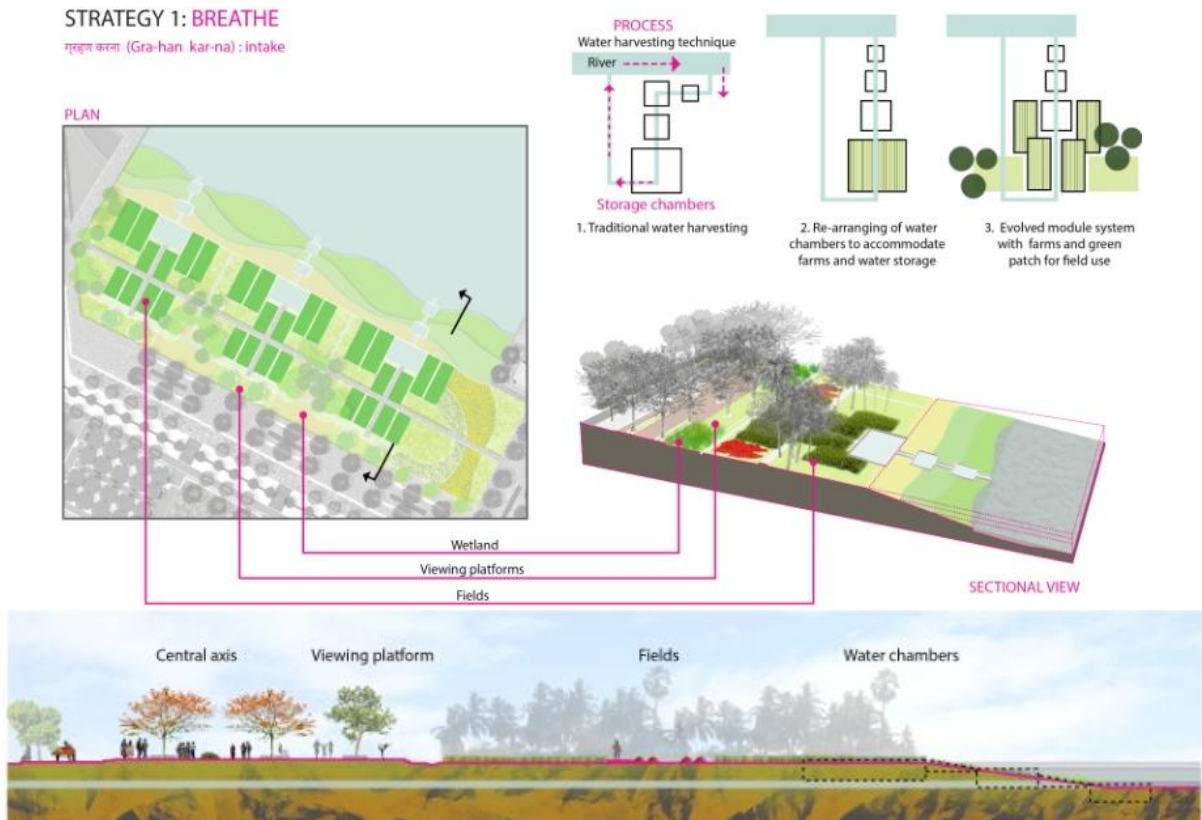


Figure 11: Image showing evolution and functioning of strategy 1.



Figure 12 : Image showing the space designed for strategy 1. It has viewing and resting space to enjoy the river and observe or experience farming. There is a platform designed for vendors to the right of the lawn area. The designed space allows small time vendors to sell flowers or fruits. The vendors have always been part of the urban streetscape of India.

which offer easy money to the farmers, can be grown in non rainy season, further helping the farmers to earn easy revenue. It is important to think of ways to engage the farmers economically since the proposed plan by the government has not touched their settlements. In addition, the space can grow crops based on seasons to mitigate flood. For example, paddy, which is the staple crop of Andhra Pradesh and has the potential to survive flooded waters, can be grown in the allocated fields during rainy season (seen in Figure 12). The area around the fields have tree plantations to prevent soil erosion. The agricultural fields have a connection with the place and make a strong tool for landscape symbolism of the place.

The second strategy is inspired by the existence of ghats along Indian riverfront. This method has series of steps which assist in the land, water and human coalescence (seen in Figure 13).The

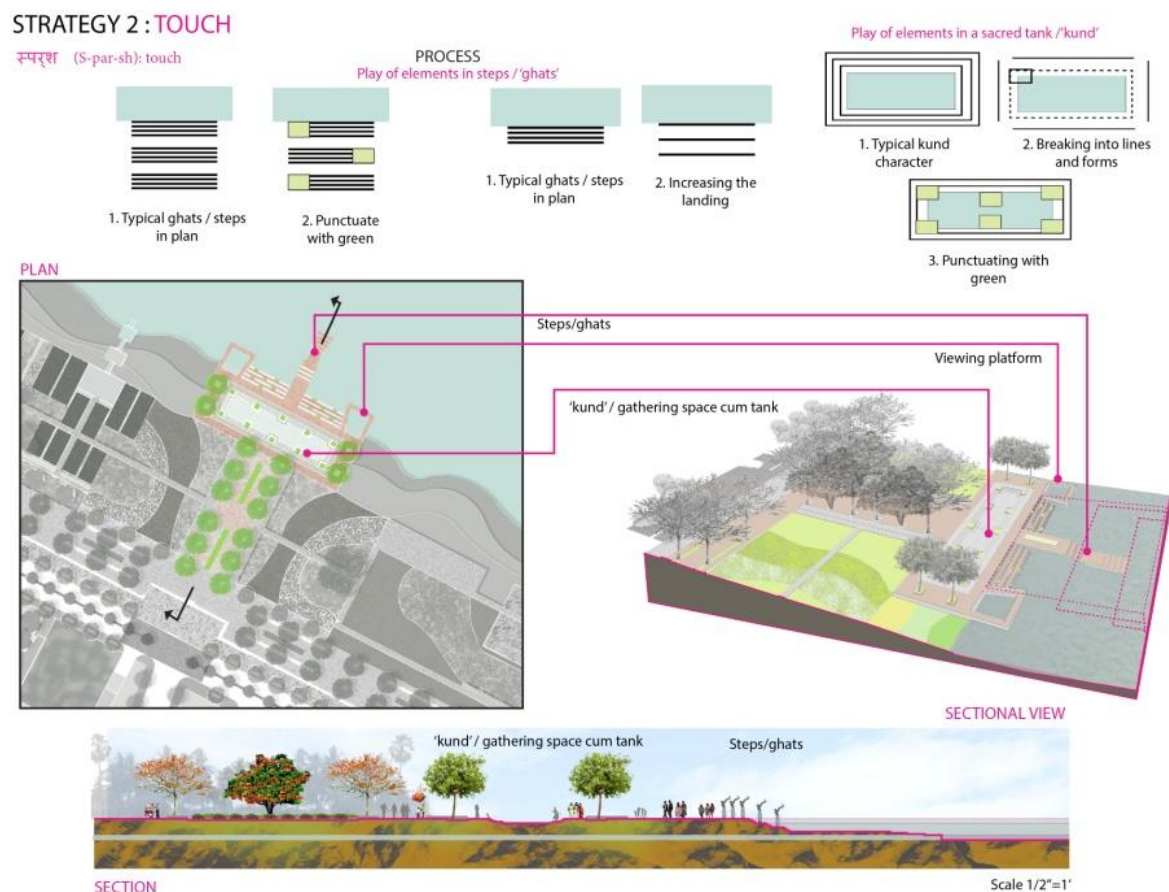


Figure 13: Image showing evolution of the strategy to derive spaces which are functional and manage water.

second strategy represents the mindful sentiment of the cultural association of the people and river. The layers of steps are softened by the sprinkling of planters. The step area is modulated from fixed width tread to wide platform in-order to accommodate more people and allow the existence of

traditional events like praying to the river (seen in Figure 14). The steps, get covered with water in times of floods. In addition, there is stepped shallow tank planned to become a central feature. The tank or 'kund' can be viewed as a controlled form before a person reaches to experience the free flowing river. Although shallow, in times of rainfall, it can store water which can be used for irrigation of green patches. On non rainy days, it forms a gathering space (seen in Figure 15).



Figure 14: Image showing, wide platforms for the steps creating a sense of floating on the river. The platforms allow larger gathering of people to perform rituals associated with the river.



Figure 15 : Image showing evolved tank / kund where people can enjoy the view the river.

The third method is inspired from the Mughal river fronts. The strategy is intended to reinforce the visual connection with the river, by placing an area of lawn overlooking the natural water body (seen in Figure 16a and 16b). Usually observed in the Mughal gardens, is a central monument around a landscape area. However, in the designed strategy, the focal point is shifted towards the river such that a larger lawn space is achieved to allow events and activities to happen (seen in Figure 17). A lotus pond renders a seamless view to the river and also lets flood water to come in. Excess water, can be used to irrigate the lawn.

STRATEGY 3 : RELEASE

विश्राम (Vi-sh-ram): relax, unwind, release)

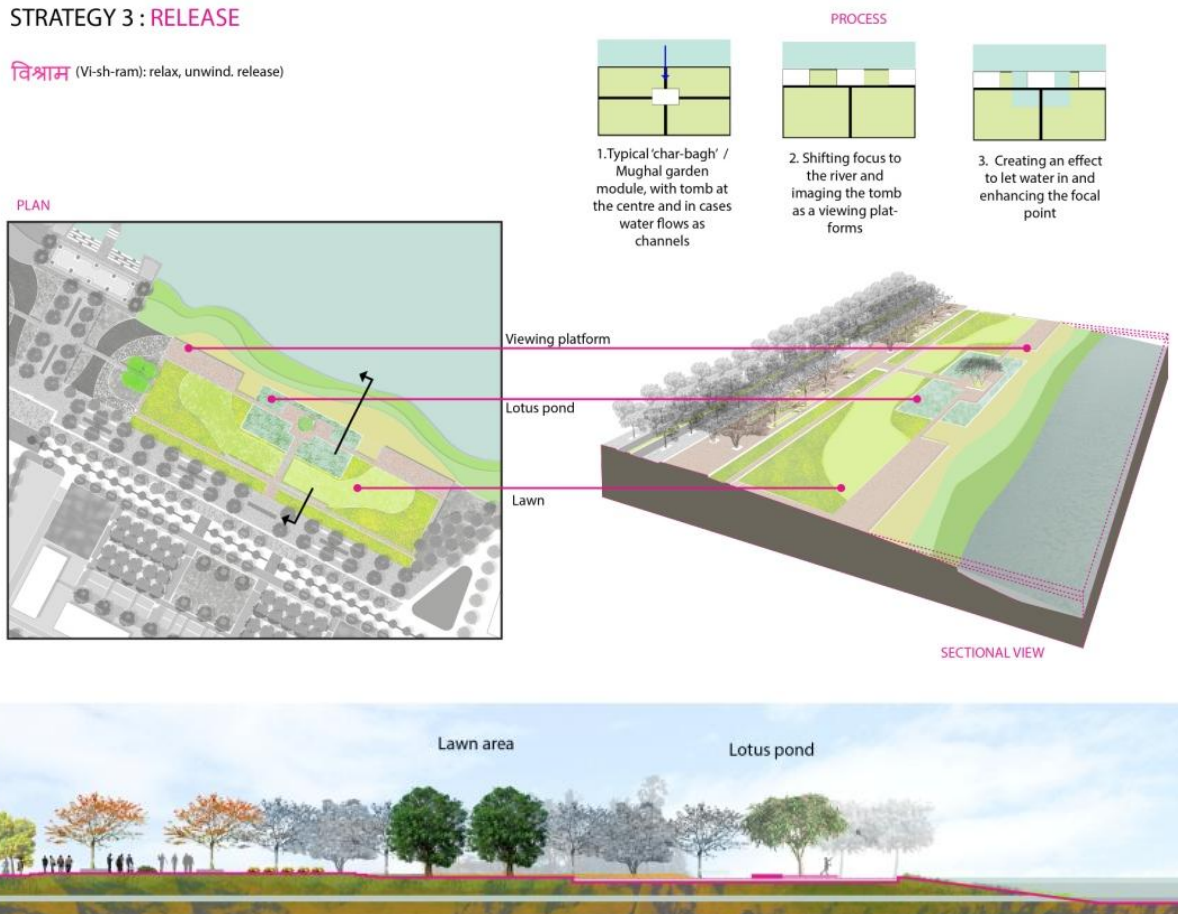


Figure 16a : Image showing evolution and functioning of strategy 3.

All the three strategies have a horizontal alliance binding, by a walking axis, situated at a higher elevation. The linear axis serves as a plaza overlooking the cultural landscape, and is envisioned to become an urban recreation spot. The central walkway has spots to rest under the trees and also has spaces where activities like selling of flowers or fruits can take place.

The region is at the border of tropical forest and dry deciduous forest. Thereby the planting palate suggested by reference from the book, Flora and Fauna of Guntur District, Andhra Pradesh India by is as follows:

Trees and Palms: *Delonix regia*, *Magnifera indica*, *Psidium guajava*, *Cassia fistula*, , *Ficus religious*, *Ficus benghalensis*, *Samanea saman*, *Pongamia glabra* *Pongamia pinnata*, *Cocos nucifera*, *Caryota urens*, *Tecoma stans*, *Azadirachta indica*, *Plumeria rubra*

Flowering plants: *Nerium oleander*, *Jasmiun*, *Crossandra*, *Tagetes* *Ixora L.*

Aquatic vegetation : (Floating Aquatics) *Nelumbo nucifera* and *Ottelia alismoides*; (Deep- Shallow marsh) *Polygonum glabra*, *Typha angustata*; (Wetland) *Ipomocea carnea*, *Phyla nodiflora*



Figure 16b: Image showing the use of the space derived from strategy 3 for events and relaxation.

4.3 Opportunities

The strategies can be further taken into the commercial blocks, south of the site. The land use is changed from pure commercial to mixed use. The grey water from these units passes through the constructed wetland (strategy 1: breathe), and upon purification enters orchard sections planted with fruit trees (strategy 2: touch), and then into the lawn space dedicated for recreation (strategy 3: release). The fruit, acquired from the orchard trees, a tangible outcome (hence related to the strategy feel), can be distributed within the site or even used for selling (seen in Figure 17 and 18). Excess water is used for infiltration or for irrigation of other green patches.

The island north of the site, by the method of cut and fill, is designed as a wetland thereby allowing the natural ecosystem to exist (seen in Figure 19). In addition, the entire designed site is proposed to be bordered by natural wetlands which will stabilise the soil and enhance the ecology of the place (seen in Figure 20).

OPPORTUNITY



Figure 17: Image showing extension of strategies into mixed use zones.

VIEW

Framing the river



Figure 18: View from pathway between the orchard area and the lawn.



Figure 19: The image on the left shows the scheme approved by the government where the island is raised to have commercial development. The image on the right shows the proposed design which can by the method of cut and fill, allow the river water to flow during floods and be a wetland area which adds to ecological diversity.

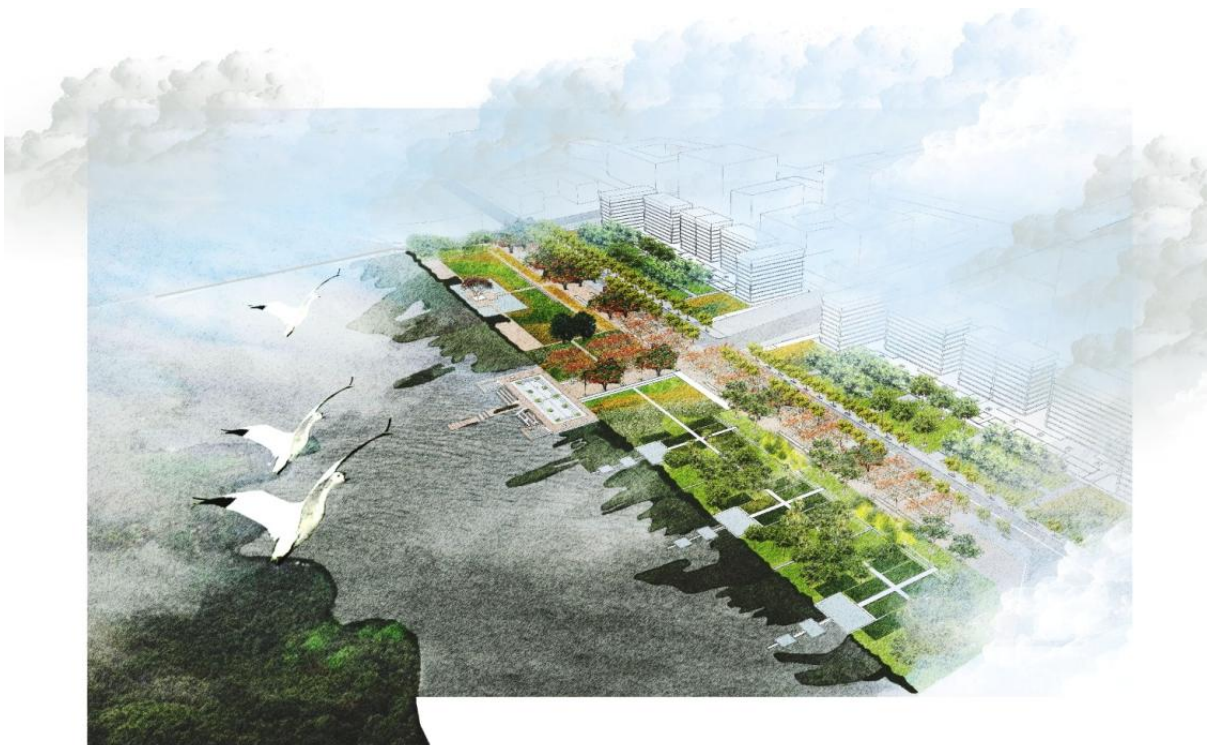


Figure 20: Aerial view of the site which shows an ecologically, socially and cultural edge.

CONCLUSION

Today, in many parts of the world, role of environmental system is being reconsidered in built cities, and priority is given to preserve natural forces by avoiding construction in environmentally sensitive area through low cost resilient strategy for water management. The battle, New Orleans is trying to fight or the struggle of Wadi Hanif, prove that natural structures need to be respected. It is important to observe that people are acknowledging the consequences of man- made engineered systems in ecologically sensitive areas, and current efforts continue to bridge the division created. Urbanisation in the flood plain will not only double the cost of construction, it will also put life and property in danger, and make it available for repetitive damage. In-case development is allowed in the flood plain, to prevent from natural disasters, humans will try and build concrete structures assuming that they have control over nature, but the truth is that nature cannot be with-held, and narrowing of the river can further worsen the situation. Urbanisation of the river or its islands in the flood plain can lead to pollution and depletion of ground water, contributing to rise in the water level of the river thereby threatening the concrete jungle by inviting natural disasters. It would be an intelligent approach to create an ecological passive social - cultural recreational facilities in the most sensitive areas of the flood plain. Furthermore, the areas which form extension of the flood plain, can have possibilities of blue- green infrastructure to handle, the runoff of the designed streets, and further mitigate any damages that can occur due to flood. Andhra Pradesh has the opportunity to truly integrate sustainability from the stand point of economics and social cultural in its capital design planning. The tools derived from social culture of space to create a public infrastructure will allow a relatable factor for people to dwell in a new capital and celebrate the ties between humans and landscape which has existed for long. The thesis demonstrates a possibility of having a public landscape infrastructure which is a derivative of socio-cultural landscape association and in addition is sensitive to the environment.

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VITA

Priyanka Malik holds an undergraduate degree in Architecture with landscape studies as an advanced elective from India. She worked for a few years in the field of landscape architecture to develop a better understanding of the profession. She is a winner of TedxDelhi logo design competition conducted in the year 2012. Priyanka began her Masters in Landscape Architecture at LSU in 2014. She likes to design urban spaces with an ecological and cultural approach.